FORM PTO-1390 (REV. 5-93)

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
2345/173

10/049867

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/06509	**10 July 2000 (10.07.00)**	**10 August 1999 (10.08.99)**

TITLE
SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE

APPLICANT(S) FOR DO/EO/US
Richard NEUMANN and Uwe SCHELLHAAS

Applicant(s) herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) . (UNSIGNED)
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
13. ☐ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification and a marked up version of the substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report, International Preliminary Examination Report (English translation) and Form PCT/RO/101.

Express Mail No.: EL244507406US

U.S. APPLICATION NO (if known, see 37 C.F.R. 1.5) 10/049867	INTERNATIONAL APPLICATION NO PCT/EP00/06509	ATTORNEY'S DOCKET NUMBER 2345/173

17. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO $890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1,040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	11 - 20 =	0	X $18.00	$0	
Independent Claims	1 - 3 =	0	X $84.00	$0	
Multiple dependent claim(s) (if applicable)			+ $280.00	$	
TOTAL OF ABOVE CALCULATIONS =				$890	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$890	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$890	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$890	
				Amount to be refunded $	
				charged $	

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No 11-0600 in the amount of $890.00 to cover the above fees. A duplicate copy of this sheet is enclosed

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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February 11, 2002
DATE

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[2345/173]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s)	:	NEUMANN et al.
Serial No.	:	10/049,867
Filed	:	February 11, 2002
International Appln No.	:	PCT/EP00/06509
International Filing Date	:	July 10, 2000
For	:	SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE
Art Unit	:	To Be Assigned
Examiner	:	To Be Assigned

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT AND
37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend without prejudice the above-identified application before examination, as set forth below.

IN THE TITLE:

Please replace the title with the following:

--SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE--.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

Please cancel without prejudice original claims 1 to 11 in the original application, and revised claims 1 to 10 in the revised pages of the annex to the International Preliminary Examination Report dated November 26, 2001 and please add new claims 12 to 21 as follows:

12. (New) A system for testing the load state of at least one device in the case of a load by a plurality of users, the device being connected to a communications network based on an IP standard, comprising

at least one programmable control device having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain an initialization procedure, a predefined test procedure, and a termination procedure;

at least one session computer connected to the control device and having a plurality of mutually independent connection interfaces, to each of which is assigned a script-processing device for executing a session script assigned by the control device, a plurality of script-processing devices being able to simultaneously establish independent IP connections via the connection interfaces assigned to them, to a device to be tested, under the control of the session scripts suitably assigned by the control device, initiate test procedures, and disconnect the IP connections.

13. (New) The test system of claim 12,

wherein, in each session computer, a session-management device is implemented, which supplies each selected script-processing device with the session script allocated to it.

14. (New) The test system of claim 12,
wherein each connection interface of a session computer has an analog or digital modem assigned thereto.

15. (New) The test system of claim 12,
wherein each connection interface of a session computer is part of an interface card and is connected to a concentrator, or each connection interface has an analog or digital model assigned thereto.

16. (New) The test system of claim 12,
wherein a plurality of session computers are linked via a backbone network to the control device.

17. (New) The test system of claim 12,
wherein each session computer includes a memory for storing status data of each device to be tested and results and preset status messages of each initiated test procedure.

18. (New) The test system of claim 17,
wherein assigned to the control device are a display device for displaying the status data on each device to be tested, stored in each session computer, and the results and status messages of each initiated test procedure, an analysis device, as well as a keyboard.

19. (New) The test system of claim 12,
wherein the communications network based on an IP standard is the Internet or an Intranet, and the devices to be tested are access routers and/or servers.

20. (New) The test system of claim 12,
wherein a session script may include a user ID, a user password, at least one service based on the IP standard, defined time sequences, repetition rates, and/or the destination address of the device to be tested.

21. (New) A method for testing the load state of at least one device in the case of a load by a plurality of users, the device being connected to a communications network based on an IP standard,

comprising the following method steps:

- writing a plurality of session scripts, which each include an initialization procedure, a predefined test procedure based on an IP standard, and a termination procedure;
- storing the session scripts in a control device;
- selecting at the control device a plurality of mutually independent connection interfaces of at least one session computer, to each of which is assigned a script-processing device;
- loading appropriate session scripts by the control device into the script-processing devices assigned to the selected connection interfaces;
- the script-processing devices assigned to the selected connection interfaces simultaneously initialize a plurality of independent IP connections to a device to be tested, under the control of the loaded session scripts, start the corresponding test procedures, and establish the IP connections;
- each test procedure initiated with respect to the device to be tested, is logged, and predefined status and/or error messages are transmitted during the running test procedures to the control device in order to be able to monitor the running test procedures.

REMARKS

This Preliminary Amendment cancels without prejudice original claims 1 to 11 in the underlying PCT Application No. PCT/EP00/06509, and cancels without prejudice claim 1 to 10 in the revised pages of the annex to the International Preliminary Examination Report dated November 26, 2001. This Preliminary Amendment also adds new claims 12 to 21. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

In accordance with 37 C.F.R. § 1.121(b)(3), the Substitute Specification (including the Abstract, but without the claims) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to

U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(iii) and § 1.125(b)(2), a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. In the Marked Up Version, double-underlining indicates added text and bracketing indicates deleted text. Approval and entry of the Substitute Specification (including Abstract) is respectfully requested.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

By: Amada Stucky
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Dated: July 2, 2002

By: Richard L. Mayer
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[2345/173]

SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE

FIELD OF THE INVENTION

The present invention relates to a system and method for testing at least one device in a communications network that is based on an IP (internet protocol) standard, by one or more users.

BACKGROUND INFORMATION

Developers, system providers and administrators of large heterogeneous network configurations based on the IP standard, such as the internet, appear to be facing mounting challenges due to the rapid growth of the Internet and the speedy advancement in transmission and hardware technology. Therefore, testing a new network or network expansions prior to actual installation, for their load state, may be considered an important task. By a load test one may mean that the targeted loading of the network, such as of the routers and servers connected to such a network, in order to determine their performance with respect to the required data throughput and the response time to a user request. There is, therefore, a need for a test system, which is able to test network components based on the IP standard, under real load conditions, to be able to ensure that all network components are functioning properly in an error-free manner, within their predefined performance limits.

The reference U.S. Patent No. 5,669,000 purportedly concerns a system for remotely testing a computer system, where instructions can be sent from a host computer 100 to so-called target machines. The target machines, in turn, perform actions that a user would otherwise undertake.

The reference European Patent No. 0 883 271 purportedly concerns a method as well as a system for managing data-service systems. The test method is suited for generating test traffic or test signals to simulate a data transmission when subscribers access services. The test system includes test devices which are set up as decentralized devices, which, via a plurality of so-called measuring routes, may allow a determination of the behavior of mutually influencing modules or the behavior of one module in the entire system.

SUMMARY OF THE INVENTION

Exemplary embodiments and/or exemplary methods of the present invention are directed to providing a test system and a test method which will enable the load of a device to be tested to be automatically tested by a plurality of network ysers, it being possible for the test system to be centrally operated by one single operator.

Further exemplary embodiments and/or exemplary methods of the present invention are directed to providing a semi-automated test system which may be able to establish a plurality of mutually independent IP connections to a communications network based on the IP standard, in order to run, via these connections, mutually independent test procedures, each corresponding to the operations of a real network user. Such a test system may be designed for testing at least one device, in the loaded state, in a communications network based on the IP standard.

Further exemplary embodiments and/or exemplary methods of the present invention are directed to providing a test system which includes at least one programmable control device having an assigned memory device in which a plurality of session scripts may be stored, each of which contains a predefined test procedure. In all the documents, a session script may be understood to mean the scripted simulation, in recorded form,

of a real network user, who performs actions based on the IP standard. The IP standard may include establishing a connection to a provider, downloading files to a server, using a web browser, and initiating a connection. A session script may contain, for example, a user identification (user ID), a user password, an IP destination address, for example, of a server connected to the communications network, the user ID and the password of such a server and the service and communications protocol utilized, such as the FTP (file transfer protocol) or the HTTP (hypertext transfer protocol). Each session script may contain a predefined number of operations that a real user could enter into a personal computer in order to request a specific IP service via the communications network.

Further exemplary embodiments and/or exemplary methods of the present invention may involve at least one session computer connected to the control device. Each session computer has a plurality of mutually independent connection interfaces, via which an independent IP connection to the communications network may be established at any one time. Assigned to each connection interface, in turn, may be a script-processing device, also called load-generating device in the following, which, in dependence upon a session script assigned by the control device, may establish an IP connection to a device to be tested and start the predefined test procedure. This can allow a running of a plurality of mutually independent test sessions in automated fashion between various simulated users and allow one or more devices to connect to the communications network, such as of a router or a server, without an operator having to manually carry out a session at the session computer.

In exemplary embodiments and/or methods of the present invention, the complexity of the test system may be enhanced by applying the same or different session scripts to a

plurality of load-generating devices of a session computer, which, in dependence upon the session script assigned in each instance by the control device, may then be able to establish a separate IP connection to one or a plurality of the devices to be tested and initiate the corresponding test procedure. To this end, implemented in each session computer may be a session-management device which supplies the session script assigned by the control device to each load-generating device.

In further exemplary embodiments and/or exemplary methods of the present invention, the session computers may be designed to support every existing network-access technology. They can be able to be readily adapted to future network-access technologies. For example, every connection interface of a session computer is connected to an analog and/or digital modem. In further exemplary embodiments and/or exemplary methods of the present invention, one or more interface cards, for example, LAN (local area network) cards, may be inserted into the session computers, which each have a plurality of connection interfaces. Further, each connection interface of a session computer may be assigned to an analog or digital modem or be linked to an available or data concentrator to interface to an ATM (asynchronous transfer mode) network. As digital modems, ISDN modems or ADSL (asymmetric digital subscriber line) modems come under consideration. In this manner, a separate IP connection may be established via each connection interface of a session computer.

The control device and the session computer connected thereto may either be implemented in one single machine or be connected via a backbone network.

To be able to log or capture or print out and later analyze the various test sequences, each session computer can have a memory for storing status data on each device to be tested and results and status messages from each initiated test

procedure. The status data of a device to be tested may be considered to be the data throughput from and to the device to be loaded, as well as its response time. The response time of a device may be understood, in this context, to be the time that the device requires to react to a specific request from a user.

Exemplary embodiments and/or exemplary methods of the present invention may includes that the session computers transfer the stored status data on the tested devices and the results and status messages from each active test procedure to the control device which is able to display this data on a display device assigned thereto and analyze the same. In addition, the control device may have a keyboard assigned to it, via which one may enter new session scripts, for example, or intervene in active test procedures in order, for example, to abnormally terminate a test procedure or reset parameters. In this manner, the test system may be adapted to any hardware and software change in the communications network, merely by writing a new session script and storing it in the control device.

The communications network based on an IP standard is, for example, the Internet or any firm-specific Intranet. As devices to be tested, access routers and servers come into consideration, for example, which belong to various service providers. Servers, which are based on an IP standard, are available and, therefore, not discussed in detail.

BRIEF DESCRIPTION OF THE DRAWING

The figure shows a test system according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

The figure shows a test system, denoted by 10, with whose assistance, the operability, for example, of the Internet 90,

in particular of its network components, such as access routers 80, or of servers 100 of various service providers connected thereto, may be tested in the loaded state. Test system 10 may also be referred to as an IP load-test system, to indicate that the test system, as well as the components to be tested with respect to their load, support IP protocols. Test system 10 includes a control and service computer 20, to which a plurality of test computers, called "session computers" in the following, are connected, in the present example, via a star coupler 30 and a so-called backbone network 35. For the sake of clarity, merely three session computers 40, 50 and 60 are schematically depicted, session computer 40 being shown in some detail. For that reason, the design of the session computers in terms of circuit technology may be explained with respect to session computer 40.

Control and service computer 20 has a keyboard, by way of which an operator may generate any permissible session scripts, for example, which are subsequently stored in a memory (not shown) assigned to control and service computer 20.

By session script, one may understand the description of an automated user, who, in conjunction with a session computer, may automatically execute IP-supported operations and activities, which a real Internet user could also undertake manually at a personal computer. In other words, each session script contains a defined test procedure, which may be used to simulate a typical behavior of a real Internet user at the session computers. Each session script may include an initialization procedure, a test procedure, as well as an end procedure. In this context, the initialization and end procedures may be executed only once in each session, while the test procedure may be carried out repeatedly. In addition, the writer of the session script may include certain error and status messages which are generated over the course of a

running test procedure. In principle, any operations and actions at all may be utilized in a session script, as long as they are based on the IP standard. Moreover, by way of control and service computer 20, variables may also be set within a session script before the test procedure is started. In this manner, generally formulated session scripts may be easily and quickly adapted to special customer requests. Other parameters, such as the number of repetitions of one test procedure and timing intervals, may likewise be defined in a session script.

Moreover, an operator at the control and service computer 20 may determine at which session computer(s) and via which connection interfaces of the selected session computers, a test procedure should be started, how many test procedures should be started at the same time, how long a test procedure lasts, or how often the same test procedure should be repeated.

Inserted into each session computer 40, 50 and 60 may be, for example, four LAN cards 42, 52 and 62, each having, for example, four separate connection interfaces 441-44n, called connection ports. To interface with Internet 90, in the present example, each connection interface may be connected to a digital ADSL modem 70, although such an interface connection is shown for connection interface 44_1. Each modem 70 may be linked via a transmission line to an access router 80 or to various routers. Test system 10 may also support any other access technology. Thus, instead of ADSL modems, ISDN routers may also be connected to the connection interfaces of the session computers. The connection interfaces of any one session computer may be linked to an available concentrator, which provides an access to an ATM network. In another case, the connection interfaces may be linked via a serial connection to analog or digital modems, with whose assistance a dial-up connection to any router and, thus, to Internet 90

may be established. As described with reference to session computer 40, a script-processing device, in the following also named load-generating device 45_1-45_n, may be assigned to each connection interface 44_1-44_n of each session computer 40, 50, and 60, as explained in greater detail further on. It should be noted here that the load-generating devices may also be implemented as software modules.

In addition, in each session computer 40, 50 and 60, a session-management device may be provided, whose task is to supply session scripts assigned by control and service computer 20 to selected load-generating devices. With regard to session computer 40, session-management device is denoted here by 46. In addition, in each session computer 40, 50, and 60, a memory may be provided in which the status data from the devices to be tested, as well as the results and status and error messages from the initiated test procedures are stored. These status data, status and error messages, and results of the test procedures in question may be transferred (transmitted or copied) from each session computer to the control and service computer 20, and stored there. In addition, the control and service computer may be designed to analyze the messages and results received from the session computers and to graphically display the same via a monitor.

At this point, it should be noted that test system 10 may be used to test IP networks with respect to their software and hardware components from various manufacturers. The operability of routers and servers within a network based on an IP standard may be tested using one single, central test system.

Test system 10 may be used to check the handling capacity of server 100 connected to Internet 90. Here, the assumption is initially made that router 80 is functioning in an error-free manner, so that error messages occurring during the test

procedure may be clearly attributed to server 100 to be tested.

An assumption may be made, based on the manufacturer's specifications, that server 100 is able to handle up to 50 users simultaneously, who, for example, want to download data via the FTP (file transfer) protocol. In this case, the operator at control and service computer 20 may select that session script which makes it possible to automatically establish a connection to server 100 to be tested, and download a dedicated file from a dedicated directory of the server. If, in the present test case, 32 queries to server 100 are simultaneously simulated, at control and service computer 32, the operator selects connection interfaces via which a test procedure should run in each instance. For this, the addresses of the connection interfaces are either entered via the keyboard of control and service computer 20, or appropriate icons are clicked on at the monitor. For example, the operator may select all 16 connection interfaces 44_1-44_n of session computer 40 and the first eight connection interfaces of the two other session computers 50 and 60, respectively, via which a test procedure should run to server 100. Control and service computer 20 subsequently may transfer the session script in question and the addresses of the selected connection interfaces to the particular intended session computers. At this point, the session-management device in each session computer may assure that the session script is loaded into all load-generating devices 451-45n of session computer 40, as well as into the first eight load-generating devices of session computers 50 and 60, respectively. Under the control of the session script, each load-generating device may establish an IP connection via the connection interface assigned to it and ADSL modem 70 connected thereto, for example via the PPPoE protocol to router 80, which may assign each connection interface its own IP address and a user password. After that, an identification may be carried out

between server 100 and the particular intended connection interface via protocol PPP. Following this initialization phase, each selected load-generating device may be prompted by the session script to execute the FTP IP service, which may prompt the server to download the files in question to the selected connection interfaces. The test procedure may be subsequently terminated by each selected or dialed load-generating device, and the connection is released. During the individual test procedures, predetermined status and error messages may be logged in the session computers to the selected connection interface messages and, at the same time, may be routed to control and service computer 20, to be able to monitor the running test procedures there. Each session computer 40, 50 and 60 may be able to determine the data throughput, as well as the response time of server 100. Since the average data throughput from and to server 100, as well as the server's response time are preset by the manufacturer, it may be determined from the calculated data throughput and from the ascertained response time, for each selected connection interface, whether server 100 has executed the 32 test procedures with or without errors. In this manner, each Internet component may be automatically tested by test system 10 with respect to its required performance features, in that appropriate session scripts are loaded into selected load-generating devices of the particular intended session computers, and are executed.

Since the connection interfaces and the load-generating devices of each session computer assigned thereto may be designed independently of one another, in the present example, users, who become active independently of one another, may be simulated using each session computer 16. For all purposes, a single operator at control and service computer 20 may suffice in order to be able to operate a test system having any number of automated users.

Exemplary embodiments and/or exemplary methods of test system 10 may allow automatic testing of a device to be tested to check the load produced by a plurality of network users. To this end, it may be only necessary for an appropriate session script to be written for each permissible user action, and to be stored in control and service computer 20. Any test situations at all may be simulated by loading appropriate session scripts onto selected load-generating devices of the particular intended session computers 40, 50, and 60, which then, independently of one another, establish separate IP connections to the devices to be tested, and execute test procedures thereon.

ABSTRACT OF THE DISCLOSURE

A system and a method for testing at least one device in a communications network based on an IP-standard (internet protocol standard), in the loaded state and/or for a plurality of users. The system and method may test the load state of the IP-based networks in a semi-automated fashion. Such a system and method may include at least one programmable control device having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain a predefined test procedure, and at least one session computer connected to the control device and has a plurality of mutually independent connection interfaces for executing at least one session script. Via each connection interface, an independent IP connection to the communications network may be established. In addition, each connection interface may have assigned to it a script-processing device, which, in dependence upon a session script assigned by the control device, is able to establish an IP connection to the device to be tested and initiate the test procedure.

[2345/173]

SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE

FIELD OF THE INVENTION

The present invention [is directed]relates to a system[, as well as to a] and method for testing at least one device in a communications network that is based on an IP ([I]internet protocol) standard, [in the loaded state]by one or more users.

BACKGROUND INFORMATION

Developers, system providers and administrators of large heterogeneous network configurations based on the IP standard, such as the [I]internet, [are]appear to be facing mounting challenges due to the rapid growth of the Internet and the speedy advancement in transmission and hardware technology. Therefore, testing a new network or network expansions prior to actual installation, for their load state, [is]may be considered an important task. By a load test[,] one [understands, quite generally,]may mean that the targeted loading of the network, [particularly]such as of the routers and servers connected to such a network, in order to determine their performance with respect to the required data throughput and the response time to a user request. There is, therefore, a need for a test system, which is able to test network components based on the IP standard, under real load conditions, to be able to ensure that all network components are functioning properly in an error-free manner, within their predefined performance limits.

The [object]reference U.S. Patent No. 5,669,000 purportedly concerns a system for remotely testing a computer system, where instructions can be sent from a host computer 100 to so-called target machines. The target machines, in turn, perform

actions that a user would otherwise undertake.

The reference European Patent No. 0 883 271 purportedly concerns a method as well as a system for managing data-service systems. The test method is suited for generating test traffic or test signals to simulate a data transmission when subscribers access services. The test system includes test devices which are set up as decentralized devices, which, via a plurality of so-called measuring routes, may allow a determination of the behavior of mutually influencing modules or the behavior of one module in the entire system.

SUMMARY OF THE INVENTION

Exemplary embodiments and/or exemplary methods of the present invention [is, therefore,]are directed to [devise]providing a test system and a test method[,] which will [be able to be adapted simply and quickly to changing IP network structures, IP access techniques and IP communications protocols, and run by a]enable the load of a device to be tested to be automatically tested by a plurality of network users, it being possible for the test system to be centrally operated by one single operator.

[The present invention achieves this technical objective, first of all, by employing the features of Claim 1.

A core idea]Further exemplary embodiments and/or exemplary methods of the present invention [is]are directed to [provide]providing a semi-automated test system[,] which [is]may be able to establish a plurality of mutually independent IP connections to a communications network based on the IP standard, in order to run, via these connections, mutually independent test procedures, [which]each [correspond]corresponding to the operations of a real network user. [In very general terms, s]Such a test system [is]may be designed for testing at least one device, in the loaded state,

in a communications network based on the IP standard.

[To this end, the test system]Further exemplary embodiments and/or exemplary methods of the present invention are directed to providing a test system which includes at least one programmable control device having an assigned memory device in which a plurality of session scripts may be stored, each of which contains a predefined test procedure. In all the documents, a session script [is]may be understood to mean the scripted simulation, in recorded form, of a real network user, who [typically]performs actions based on the IP standard[, such as]. The IP standard may include establishing a connection to a provider, downloading files to a server, using a web browser, and initiating [the]a connection. A session script may contain, for example, a user identification (user ID), a user password, an IP destination address, for example, of a server connected to the communications network, the user ID and the password of such a server and the service and communications protocol utilized, such as the FTP (file transfer protocol) or the HTTP (hypertext transfer protocol). [It is important to point out that e]Each session script may contain[s] a predefined number of operations that a real user could enter into a personal computer in order to request a specific IP service via the communications network.

[In addition,]Further exemplary embodiments and/or exemplary methods of the present invention may involve at least one session computer[is] connected to the control device. Each session computer has a plurality of mutually independent connection interfaces, via which an independent IP connection to the communications network may be established at any one time. Assigned to each connection interface, in turn, [is]may be a script-processing device, also called load-generating device in the following, which, in dependence upon a session script assigned by the control device, may establish an IP connection to a device to be tested and start the predefined

test procedure. This [makes it possible to run]can allow a running of a plurality of mutually independent test sessions in automated fashion between various simulated users and allow one or more devices to connect[ed] to the communications network, such as of a router or a server, without an operator having to manually carry out a session at the session computer.

[T]In exemplary embodiments and/or methods of the present invention, the complexity of the test system may be enhanced by applying the same or different session scripts to a plurality of load-generating devices of a session computer, which, in dependence upon the session script assigned in each instance by the control device, [are]may then be able to establish a separate IP connection to one or a plurality of the devices to be tested and initiate the corresponding test procedure. To this end, implemented in each session computer [is]may be a session-management device which supplies the session script assigned by the control device to each load-generating device.

[T]In further exemplary embodiments and/or exemplary methods of the present invention, the session computers [are]may be designed to support every existing network-access technology. They [will]can be able to be readily adapted to future network-access technologies. For example, every connection interface of a session computer [may be]is connected to an analog and/or digital modem. [It is also practical to insert]In further exemplary embodiments and/or exemplary methods of the present invention, one or more interface cards, for example, LAN (local area network) cards, may be inserted into the session computers, which each have a plurality of connection interfaces. [On the other hand]Further, each connection interface of a session computer may be assigned to an analog or digital modem or be linked to [a conventional concentrator]an available or data concentrator to interface to

an ATM (asynchronous transfer mode) network. As digital modems, ISDN modems or ADSL (asymmetric digital subscriber line) modems come under consideration. In this manner, a separate IP connection may be established via each connection interface of a session computer.

The control device and the session computer connected thereto may either be implemented in one single machine or be connected via a backbone network.

To be able to log or capture or print out and later analyze the various test sequences, each session computer can ha[s]ve a memory for storing status data on each device to be tested and results and status messages from each initiated test procedure. The status data of a device to be tested [are]may be considered[, in particular,] to be the data throughput from and to the device to be loaded, as well as its response time. The response time of a device [is]may be understood, in this context, to be the time that the device requires to react to a specific request from a user.

[T]Exemplary embodiments and/or exemplary methods of the present invention may includes that the session computers transfer the stored status data on the tested devices and the results and status messages from each active test procedure to the control device which is able to display this data on a display device assigned thereto and analyze the same. In addition, the control device may ha[s]ve a keyboard assigned to it, via which one may enter new session scripts, for example, or intervene in active test procedures in order, for example, to abnormally terminate a test procedure or reset parameters. In this manner, the test system may be adapted to any hardware and software change in the communications network, merely by writing a new session script and storing it in the control device.

The communications network based on an IP standard is, for example, the Internet or any firm-specific Intranet. As devices to be tested, access routers and servers come into consideration, for example, which belong to various service providers. Servers, which are based on an IP standard, are [generally known]available and[are], therefore, not discussed in detail.

[The technical objective is likewise achieved by the method steps of Claim 10.

An advantageous further embodiment constitutes the subject matter of dependent Claim 11.

The present invention is elucidated in the following on the basis of]BRIEF DESCRIPTION OF THE DRAWING

The figure shows a test system according to an exemplary embodiment[, in conjunction with] of the [enclosed figure]present invention.

DETAILED DESCRIPTION

The figure shows a test system, denoted by 10, with whose assistance,[one may test] the operability, for example, of the Internet 90, in particular of its network components, such as access routers 80, or of servers 100 of various service providers connected thereto, may be tested in the loaded state. Test system 10 may also be referred to as an IP load-test system, to indicate that the test system, as well as the components to be tested with respect to their load, support IP protocols. Test system 10 includes a control and service computer 20, to which a plurality of test computers, called "session computers" in the following, are connected, in the present example, via a star coupler 30 and a so-called backbone network 35. For the sake of clarity, merely three session computers 40, 50 and 60 are schematically depicted, session computer 40 being shown in [greater]some detail. For

that reason, the design of the session computers in terms of circuit technology [is principally]may be explained with respect to session computer 40.

Control and service computer 20 has a keyboard, by way of which an operator may generate any permissible session scripts, for example, which are subsequently stored in a memory (not shown) assigned to control and service computer 20.

By session script, one [understands, quite generally,]may understand the description of an automated user, who, in conjunction with a session computer, may automatically execute IP-supported operations and activities, which a real Internet user could also undertake manually at a personal computer. In other words, each session script contains a defined test procedure, which may be used to simulate a typical behavior of a real Internet user at the session computers. Each session script may include[s] an initialization procedure, a test procedure, as well as an end procedure. In this context, the initialization and end procedures [are]may be executed only once in each session, while the test procedure may be carried out repeatedly. In addition, the writer of the session script may include certain error and status messages which are generated over the course of a running test procedure. In principle, any operations and actions at all may be utilized in a session script, as long as they are based on the IP standard. Moreover, by way of control and service computer 20, variables may also be set within a session script before the test procedure is started. In this manner, generally formulated session scripts may be easily and quickly adapted to special customer requests. Other parameters, such as the number of repetitions of one test procedure and timing intervals, may likewise be defined in a session script.

Moreover, an operator at the control and service computer 20

may determine at which session computer(s) and via which connection interfaces of the selected session computers, a test procedure should be started, how many test procedures should be started at the same time, how long a test procedure lasts, or how often the same test procedure should be repeated.

Inserted into each session computer 40, 50 and 60 [are]may be, for example, four LAN cards 42, 52 and 62, [which, in turn,]each [have]having, for example, four separate connection interfaces 441-44n,[also] called connection ports. To interface with Internet 90, in the present example, each connection interface [is]may be connected to a digital ADSL modem 70, although such an interface connection is[only] shown for connection interface 44_1. Each modem 70 may be linked via a transmission line to an access router 80 or to various routers. [It goes without saying that t]Test system 10 may also support any other access technology. Thus, instead of ADSL modems, ISDN routers may also be connected to the connection interfaces of the session computers. [It is also conceivable to link]The connection interfaces of any one session computer may be linked to a[generally known]n available concentrator, which provides an access to an ATM network. In another case, [it is possible to link]the connection interfaces may be linked via a serial connection to analog or digital modems, with whose assistance a dial-up connection to any router and, thus, to Internet 90 may be established. As described with reference to session computer 40, a script-processing device, in the following also named load-generating device 45_1-45_n, [is]may be assigned to each connection interface 44_1-44_n of each session computer 40, 50, and 60, as explained in greater detail further on. It should be noted here that the load-generating devices may also be implemented as software modules.

In addition, in each session computer 40, 50 and 60, a

session-management device [is]may be provided, whose task is to supply session scripts assigned by control and service computer 20 to selected load-generating devices. With regard to session computer 40, session-management device is denoted here by 46. In addition, in each session computer 40, 50, and 60, a memory may be provided in which the status data from the devices to be tested, as well as the results and status and error messages from the initiated test procedures are stored. These status data, status and error messages, and results of the test procedures in question may be transferred (transmitted or copied) from each session computer to the control and service computer 20, and stored there. In addition, the control and service computer [is]may be designed to analyze the messages and results received from the session computers and to graphically display the same via a monitor.

At this point, it should be noted that test system 10 may be used to test IP networks with respect to their software and hardware components from various manufacturers. [It is, thus, possible to test t]The operability of routers and servers within a network based on an IP standard[,] may be tested using one single, central test system.

[A scenario is used in the following to elucidate the method of functioning of t]Test system 10[.

The intention here is for test system 10] may be used to check the handling capacity of server 100 connected to Internet 90. Here, the assumption is initially made that router 80 is functioning in an error-free manner, so that error messages occurring during the test procedure may be clearly attributed to server 100 to be tested.

[The]An assumption [is also]may be made, based on the manufacturer's specifications, that server 100 is able to handle up to 50 users simultaneously, who, for example, want

to download data via the FTP (file transfer) protocol. In this case, the operator at control and service computer 20 may select[s] that session script which makes it possible to automatically establish a connection to server 100 to be tested, and download a dedicated file from a dedicated directory of the server. If, in the present test case, 32 queries to server 100 are simultaneously simulated, at control and service computer 32, the operator selects connection interfaces via which a test procedure should run in each instance. For this, the addresses of the connection interfaces are either entered via the keyboard of control and service computer 20, or appropriate icons are clicked on at the monitor. For example, the operator may select[s] all 16 connection interfaces 44_1-44_n of session computer 40 and the first eight connection interfaces of the two other session computers 50 and 60, respectively, via which a test procedure should run to server 100. Control and service computer 20 subsequently may transfer[s] the session script in question and the addresses of the selected connection interfaces to the particular intended session computers. At this point, the session-management device in each session computer may assure[s] that the session script is loaded into all load-generating devices 451-45n of session computer 40, as well as into the first eight load-generating devices of session computers 50 and 60, respectively. Under the control of the session script, each load-generating device may establish[es] an IP connection via the connection interface assigned to it and ADSL modem 70 connected thereto, for example via the PPPoE protocol to router 80, which may assign[s] each connection interface its own IP address and a user password. After that, an identification [is]may be carried out between server 100 and the particular intended connection interface via protocol PPP. Following this initialization phase, each selected load-generating device [is]may be prompted by the session script to execute the FTP IP service, which may prompt[s] the server to download the

files in question to the selected connection interfaces. The test procedure [is]may be subsequently terminated by each selected or dialed load-generating device, and the connection is released. During the individual test procedures, predetermined status and error messages [are]may be logged in the session computers to the selected connection interface messages and, at the same time, may be routed to control and service computer 20, to be able to monitor the running test procedures there. Each session computer 40, 50 and 60 [is]may be able to determine the data throughput, as well as the response time of server 100. Since the average data throughput from and to server 100, as well as the server's response time are preset by the manufacturer, it may be determined from the calculated data throughput and from the ascertained response time, for each selected connection interface, whether server 100 has executed the 32 test procedures with or without errors. In this manner, each Internet component may be automatically tested by test system 10 with respect to its required performance features, in that appropriate session scripts are loaded into selected load-generating devices of the particular intended session computers, and are executed.

Since the connection interfaces and the load-generating devices of each session computer assigned thereto [are]may be designed independently of one another, in the present example, users, who become active independently of one another, may be simulated using each session computer 16. [To]For all[intents and] purposes, a single operator at control and service computer 20 may suffice[s] in order to be able to operate a test system having any number of automated users.

[Thanks to test system 10, it is possible to automatically test]Exemplary embodiments and/or exemplary methods of test system 10 may allow automatic testing of a device to be tested to check the load produced by a plurality of network users. To this end, it [is merely]may be only necessary for an

appropriate session script to be written for each permissible user action, and to be stored in control and service computer 20. Any test situations at all may be simulated by loading appropriate session scripts onto selected load-generating devices of the particular intended session computers 40, 50, and 60, which then, independently of one another, establish separate IP connections to the devices to be tested, and execute test procedures thereon.

[Abstract

]

ABSTRACT OF THE DISCLOSURE

[The present invention is directed to a]A system[, as well as to] and a method for testing at least one device in a communications network based on an [IP]IP-standard ([I]internet protocol[)] standard), in the loaded state and/or for a plurality of users. [At t]The[present time, no] system[s are known which can be used so] and method may test the load state of the IP[-]-based networks in a semi[-]-automated fashion. Such a system [(10)]and method may include[s] at least one programmable control device[(20)] having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain a predefined test procedure, and at least one session computer [(40, 50, 60)]connected to the control device [(20)]and [having]has a plurality of mutually independent connection interfaces[(44_1-44_r)] for executing at least one session script. Via each connection interface, an independent IP connection to the communications network [(90) is able to]may be established. In addition, each connection interface[(44_1-44_r)] may ha[s]ve assigned to it a script-processing device[(45_1-45_r)], which, in dependence upon a session script assigned by the control device[(20)], is able to establish an IP connection to the device[(80, 100)] to be tested and initiate the test procedure.

1/Prts

[2345/173]

SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE

The present invention is directed to a system, as well as to a method for testing at least one device in a communications network that is based on an IP (Internet protocol) standard, in the loaded state.

Developers, system providers and administrators of large heterogeneous network configurations based on the IP standard, such as the Internet, are facing mounting challenges due to the rapid growth of the Internet and the speedy advancement in transmission and hardware technology. Therefore, testing a new network or network expansions prior to actual installation, for their load state, is considered an important task. By a load test, one understands, quite generally, the targeted loading of the network, particularly of the routers and servers connected to such a network, in order to determine their performance with respect to the required data throughput and the response time to a user request. There is, therefore, a need for a test system, which is able to test network components based on the IP standard, under real load conditions, to be able to ensure that all network components are functioning properly in an error-free manner, within their predefined performance limits.

The object of the present invention is, therefore, to devise a test system and a test method, which will be able to be adapted simply and quickly to changing IP network structures, IP access techniques and IP communications protocols, and run by a single operator.

The present invention achieves this technical objective, first of all, by employing the features of Claim 1.

A core idea of the present invention is to provide a semi-automated test system, which is able to establish a plurality of mutually independent IP connections to a communications network based on the IP standard, in order to run, via these connections, mutually independent test procedures, which each correspond to the operations of a real network user. In very general terms, such a test system is designed for testing at least one device, in the loaded state, in a communications network based on the IP standard.

To this end, the test system includes at least one programmable control device having an assigned memory device in which a plurality of session scripts may be stored, each of which contains a predefined test procedure. In all the documents, a session script is understood to mean the scripted simulation, in recorded form, of a real network user, who typically performs actions based on the IP standard, such as establishing a connection to a provider, downloading files to a server, using a web browser, and initiating the connection. A session script may contain, for example, a user ID, a user password, an IP destination address, for example of a server connected to the communications network, the user ID and the password of such a server and the service and communications protocol utilized, such as the FTP (file transfer protocol) or the HTTP (hypertext transfer protocol). It is important to point out that each session script contains a predefined number of operations that a real user could enter into a personal computer in order to request a specific IP service via the communications network.

In addition, at least one session computer is connected to the control device. Each session computer has a plurality of mutually independent connection interfaces, via which an independent IP connection to the communications network may be established at any one time. Assigned to each connection interface, in turn, is a script-processing device, also called load-generating device in the following, which, in dependence

upon a session script assigned by the control device, may establish an IP connection to a device to be tested and start the predefined test procedure. This makes it possible to run a plurality of mutually independent test sessions in automated fashion between various simulated users and one or more devices connected to the communications network, such as of a router or a server, without an operator having to manually carry out a session at the session computer.

The complexity of the test system may be enhanced by applying the same or different session scripts to a plurality of load-generating devices of a session computer, which, in dependence upon the session script assigned in each instance by the control device, are then able to establish a separate IP connection to one or a plurality of the devices to be tested and initiate the corresponding test procedure. To this end, implemented in each session computer is a session-management device which supplies the session script assigned by the control device to each load-generating device.

The session computers are designed to support every existing network-access technology. They will be able to be readily adapted to future network-access technologies. For example, every connection interface of a session computer may be connected to an analog and/or digital modem. It is also practical to insert one or more interface cards, for example LAN cards, into the session computers, which each have a plurality of connection interfaces. On the other hand, each connection interface of a session computer may be assigned to an analog or digital modem or be linked to a conventional concentrator to interface to an ATM (asynchronous transfer mode) network. As digital modems, ISDN modems or ADSL (asymmetric digital subscriber line) modems come under consideration. In this manner, a separate IP connection may be established via each connection interface of a session computer.

The control device and the session computer connected thereto may either be implemented in one single machine or be connected via a backbone network.

To be able to log and later analyze the various test sequences, each session computer has a memory for storing status data on each device to be tested and results and status messages from each initiated test procedure. The status data of a device to be tested are considered, in particular, to be the data throughput from and to the device to be loaded, as well as its response time. The response time of a device is understood, in this context, to be the time that the device requires to react to a specific request from a user.

The session computers transfer the stored status data on the tested devices and the results and status messages from each active test procedure to the control device which is able to display this data on a display device assigned thereto and analyze the same. In addition, the control device has a keyboard assigned to it, via which one may enter new session scripts, for example, or intervene in active test procedures in order, for example, to abnormally terminate a test procedure or reset parameters. In this manner, the test system may be adapted to any hardware and software change in the communications network, merely by writing a new session script and storing it in the control device.

The communications network based on an IP standard is, for example, the Internet or any firm-specific Intranet. As devices to be tested, access routers and servers come into consideration, for example, which belong to various service providers. Servers, which are based on an IP standard, are generally known and are, therefore, not discussed in detail.

The technical objective is likewise achieved by the method steps of Claim 10.

An advantageous further embodiment constitutes the subject matter of dependent Claim 11.

The present invention is elucidated in the following on the basis of an exemplary embodiment, in conjunction with the enclosed figure.

The figure shows a test system, denoted by 10, with whose assistance, one may test the operability, for example, of the Internet 90, in particular of its network components, such as access routers 80, or of servers 100 of various service providers connected thereto, in the loaded state. Test system 10 may also be referred to as an IP load-test system, to indicate that the test system, as well as the components to be tested with respect to their load, support IP protocols. Test system 10 includes a control and service computer 20, to which a plurality of test computers, called "session computers" in the following, are connected, in the present example, via a star coupler 30 and a so-called backbone network 35. For the sake of clarity, merely three session computers 40, 50 and 60 are schematically depicted, session computer 40 being shown in greater detail. For that reason, the design of the session computers in terms of circuit technology is principally explained with respect to session computer 40.

Control and service computer 20 has a keyboard, by way of which an operator may generate any permissible session scripts, for example, which are subsequently stored in a memory (not shown) assigned to control and service computer 20.

By session script, one understands, quite generally, the description of an automated user, who, in conjunction with a session computer, may automatically execute IP-supported operations and activities, which a real Internet user could also undertake manually at a personal computer. In other words, each session script contains a defined test procedure,

which may be used to simulate a typical behavior of a real Internet user at the session computers. Each session script includes an initialization procedure, a test procedure, as well as an end procedure. In this context, the initialization and end procedures are executed only once in each session, while the test procedure may be carried out repeatedly. In addition, the writer of the session script may include certain error and status messages which are generated over the course of a running test procedure. In principle, any operations and actions at all may be utilized in a session script, as long as they are based on the IP standard. Moreover, by way of control and service computer 20, variables may also be set within a session script before the test procedure is started. In this manner, generally formulated session scripts may be easily and quickly adapted to special customer requests. Other parameters, such as the number of repetitions of one test procedure and timing intervals, may likewise be defined in a session script.

Moreover, an operator at the control and service computer 20 may determine at which session computer(s) and via which connection interfaces of the selected session computers, a test procedure should be started, how many test procedures should be started at the same time, how long a test procedure lasts, or how often the same test procedure should be repeated.

Inserted into each session computer 40, 50 and 60 are, for example, four LAN cards 42, 52 and 62, which, in turn, each have four separate connection interfaces 441-44n, also called connection ports. To interface with Internet 90, in the present example, each connection interface is connected to a digital ADSL modem 70, although such an interface connection is only shown for connection interface 44_1. Each modem 70 may be linked via a transmission line to an access router 80 or to various routers. It goes without saying that test system 10 may also support any other access technology. Thus, instead of

ADSL modems, ISDN routers may also be connected to the connection interfaces of the session computers. It is also conceivable to link connection interfaces of any one session computer to a generally known concentrator, which provides an access to an ATM network. In another case, it is possible to link the connection interfaces via a serial connection to analog or digital modems, with whose assistance a dial-up connection to any router and, thus, to Internet 90 may be established. As described with reference to session computer 40, a script-processing device, in the following also named load-generating device 45_1-45_n, is assigned to each connection interface 44_1-44_n of each session computer 40, 50, and 60, as explained in greater detail further on. It should be noted here that the load-generating devices may also be implemented as software modules.

In addition, in each session computer 40, 50 and 60, a session-management device is provided, whose task is to supply session scripts assigned by control and service computer 20 to selected load-generating devices. With regard to session computer 40, session-management device is denoted by 46. In addition, in each session computer 40, 50, and 60, a memory may be provided in which the status data from the devices to be tested, as well as the results and status and error messages from the initiated test procedures are stored. These status data, status and error messages, and results of the test procedures in question may be transferred from each session computer to the control and service computer 20, and stored there. In addition, the control and service computer is designed to analyze the messages and results received from the session computers and to graphically display the same via a monitor.

At this point, it should be noted that test system 10 may be used to test IP networks with respect to their software and hardware components from various manufacturers. It is, thus, possible to test the operability of routers and servers within

a network based on an IP standard, using one single, central test system.

A scenario is used in the following to elucidate the method of functioning of test system 10.

The intention here is for test system 10 to check the handling capacity of server 100 connected to Internet 90. Here, the assumption is initially made that router 80 is functioning in an error-free manner, so that error messages occurring during the test procedure may be clearly attributed to server 100 to be tested.

The assumption is also made, based on the manufacturer's specifications, that server 100 is able to handle up to 50 users simultaneously, who, for example, want to download data via the FTP protocol. In this case, the operator at control and service computer 20 selects that session script which makes it possible to automatically establish a connection to server 100 to be tested, and download a dedicated file from a dedicated directory of the server. If, in the present test case, 32 queries to server 100 are simultaneously simulated, at control and service computer 32, the operator selects connection interfaces via which a test procedure should run in each instance. For this, the addresses of the connection interfaces are either entered via the keyboard of control and service computer 20, or appropriate icons are clicked on at the monitor. For example, the operator selects all 16 connection interfaces 44_1-44_n of session computer 40 and the first eight connection interfaces of the two other session computers 50 and 60, respectively, via which a test procedure should run to server 100. Control and service computer 20 subsequently transfers the session script in question and the addresses of the selected connection interfaces to the particular intended session computers. At this point, the session-management device in each session computer assures that the session script is loaded into all load-generating

devices 451-45n of session computer 40, as well as into the first eight load-generating devices of session computers 50 and 60, respectively. Under the control of the session script, each load-generating device establishes an IP connection via the connection interface assigned to it and ADSL modem 70 connected thereto, for example via the PPPoE protocol to router 80, which assigns each connection interface its own IP address and a user password. After that, an identification is carried out between server 100 and the particular intended connection interface via protocol PPP. Following this initialization phase, each selected load-generating device is prompted by the session script to execute the FTP IP service, which prompts the server to download the files in question to the selected connection interfaces. The test procedure is subsequently terminated by each selected load-generating device, and the connection is released. During the individual test procedures, predetermined status and error messages are logged in the session computers to the selected connection interface messages and, at the same time, routed to control and service computer 20, to be able to monitor the running test procedures there. Each session computer 40, 50 and 60 is able to determine the data throughput, as well as the response time of server 100. Since the average data throughput from and to server 100, as well as the server's response time are preset by the manufacturer, it may be determined from the calculated data throughput and from the ascertained response time, for each selected connection interface, whether server 100 has executed the 32 test procedures with or without errors. In this manner, each Internet component may be automatically tested by test system 10 with respect to its required performance features, in that appropriate session scripts are loaded into selected load-generating devices of the particular intended session computers, and are executed.

Since the connection interfaces and the load-generating devices of each session computer assigned thereto are designed independently of one another, in the present example, users,

who become active independently of one another, may be simulated using each session computer 16. To all intents and purposes, a single operator at control and service computer 20 suffices in order to be able to operate a test system having any number of automated users.

Thanks to test system 10, it is possible to automatically test a device to be tested to check the load produced by a plurality of network users. To this end, it is merely necessary for an appropriate session script to be written for each permissible user action, and to be stored in control and service computer 20. Any test situations at all may be simulated by loading appropriate session scripts onto selected load-generating devices of the particular intended session computers 40, 50, and 60, which then, independently of one another, establish separate IP connections to the devices to be tested, and execute test procedures thereon.

What is claimed is:

1. A system (10) for testing at least one device in a communications network (90) based on an IP standard, in the loaded state, comprising at least one programmable control device (20) having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain a predefined test procedure, at least one session computer (40, 50, 60) connected to the control device (20) and having a plurality of mutually independent connection interfaces (441-44n) for executing at least one session script; via each connection interface, an independent IP connection to the communications network (90) being able to be established, and each connection interface (44_1-44_n) having assigned to it a script-processing device (45_1-45_n), which, in dependence upon a session script assigned by the control device (20), is able to establish an IP connection to the device (80, 100) to be tested and initiate the test procedure.

2. The test system as recited in Claim 1, wherein, in each session computer (40, 50, 60), a session-management device (46) is implemented, which supplies each selected script-processing device with the session script allocated to it.

3. The test system as recited in Claim 1 or 2, wherein each connection interface (44_1-44_n) of a session computer (40, 50, 60) has an analog or digital modem (70) assigned thereto.

4. The test system as recited in Claim 1 or 2, wherein each connection interface (44_1-44_n) of a session computer (42, 52, 62) is part of an interface card (42, 52, 62) and is connected to a concentrator, or each connection interface (44_1-44_n) has an analog or digital model (70) assigned thereto.

5. The test system as recited in one of Claims 1 through 4, wherein a plurality of session computers (40, 50, 60) are linked via a backbone network (35) to the control device (20).

6. The test system as recited in one of Claims 1 through 5, wherein each session computer (40, 50, 60) includes a memory for storing status data of each device to be tested and results and preset status messages of each initiated test procedure.

7. The test system as recited in Claim 6, wherein assigned to the control device (20) are a display device for displaying the status data on each device to be tested, stored in each session computer, and the results and status messages of each initiated test procedure, an analysis device, as well as a keyboard.

8. The test system as recited in one of Claims 1 through 7, wherein the communications network (90) based on an IP standard is the Internet or an Intranet, and the devices (80, 100) to be tested are access routers and/or servers.

9. The test system as recited in one of Claims 1 through 8, wherein a session script may include a user ID, a user password, at least one service based on the IP standard, defined time sequences, repetition rates, and/or the destination address of the device to be tested.

10. A method for testing at least one device in a communications network based on an IP standard, in the loaded state, comprising the following method steps:
    - writing a plurality of session scripts, which each include a predefined test procedure based on an IP standard;
    - storing the session scripts in a control device;
    - loading at least one selected session script into at least one session computer;
    - functioning in response to each loaded session script, a separate IP connection is established to at least one device to be tested, and the corresponding test procedure is initiated.

11. The method as recited in Claim 9, wherein each test procedure initiated by a session computer is logged, and predefined messages are transmitted during the running test procedures to the control device and displayed at a display device.

Abstract

The present invention is directed to a system, as well as to a method for testing at least one device in a communications network based on an IP (Internet protocol) standard, in the loaded state. At the present time, no systems are known which can be used to test the load state of IP-based networks in a semi-automated fashion. Such a system (10) includes at least one programmable control device (20) having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain a predefined test procedure, and at least one session computer (40, 50, 60) connected to the control device (20) and having a plurality of mutually independent connection interfaces (44_1-44_n) for executing at least one session script. Via each connection interface, an independent IP connection to the communications network (90) is able to be established. In addition, each connection interface (44_1-44_n) has assigned to it a script-processing device (45_1-45_n), which, in dependence upon a session script assigned by the control device (20), is able to establish an IP connection to the device (80, 100) to be tested and initiate the test procedure.

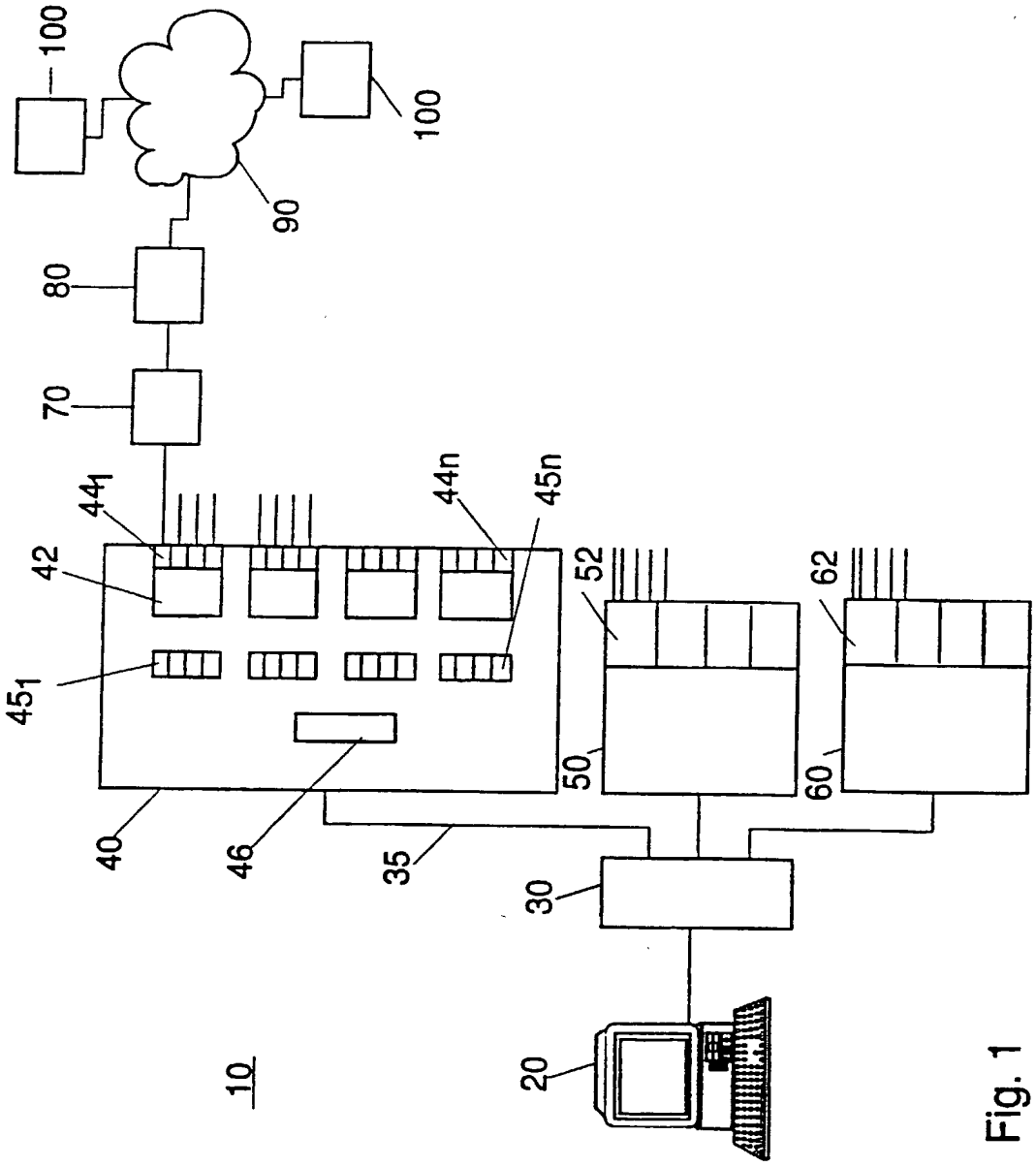

Fig. 1

2345/173

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **SYSTEM AND METHOD FOR TESTING THE LOAD OF AT LEAST ONE IP-SUPPORTED DEVICE**, the specification of which was filed as International Application No. PCT/EP00/06509 on July 10, 2000 and filed as a U.S. application having a Serial No. 10/049,867 on February 11, 2002 for Letters Patent in the U.S. Patent and Trademark Office.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

Number	Country Filed	Day/Month/Year	Priority Claimed Under 35 USC 119
199 377 53.7	Fed. Rep. of Germany	August 10, 1999	Yes

EV[illegible]

And I hereby appoint Richard L. Mayer (Reg. No. 22,490), Gerard A. Messina (Reg. No. 35,952) and Linda M. Shudy (Reg. No. 47,084) my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful and false statements may jeopardize the validity of the application or any patent issued thereon.

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